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Lake County, California

National Eutrophication Survey, Corvallis, Oreg

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1978

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NATIONAL EUTROPHICATION SURVEY

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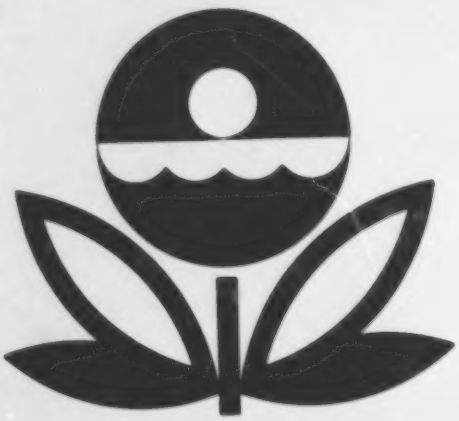

REPORT

ON

LAKE PILLSBURY

LAKE COUNTY

CALIFORNIA

EPA REGION IX

WORKING PAPER No. 755

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentration (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the California State Water Resources Control Board and the nine Regional Water Quality Control Boards for professional involvement, to the California National Guard for conducting the tributary sampling phase of the Survey, and to those California wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Division of Planning and Research of the State Water Resources Control Board provided invaluable lake documentation and counsel during the Survey, coordinated the reviews of the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

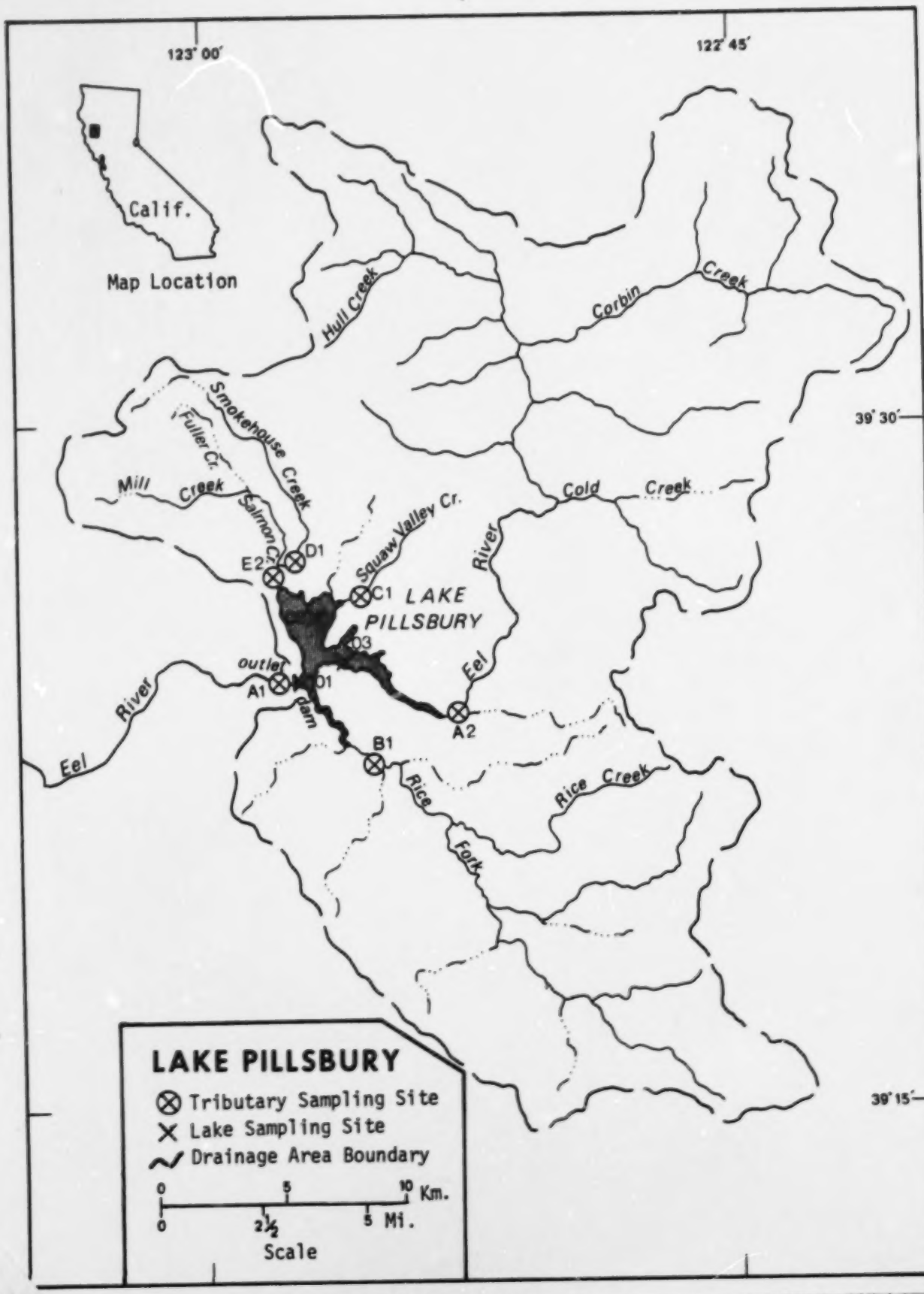
Major General Glen C. Ames, the Adjutant General of California, and Project Officer Second Lieutenant Terry L. Barrie, who directed the volunteer efforts of the California National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY RESERVOIRS

State of California

Name	County
Amador	Amador
Boca	Nevada
Britton	Shasta
Casitas	Ventura
Crowley	Mono
Don Pedro	Tuolumne
Elsinore	Riverside
Fallen Leaf	El Dorado
Hennessey	Napa
Henshaw	San Diego
Iron Gate	Siskiyou
Lopez	San Luis Obispo
Mary	Mono
Mendocino	Mendocino
Nicasio	Marin
Lower Otay	San Diego
Pillsbury	Lake
Santa Margarita	San Luis Obispo
Shasta	Shasta
Shaver	Fresno
Silver	Mono
Tahoe	El Dorado, Placer, CA; Carson City, Douglas, Washoe, NV
Tulloch	Calaveras, Tuolumne
Lower Twin	Mono
Upper Twin	Mono


123° 00'
122° 45'
39° 30'
39° 15'
Calif.
Map Location
Hull Creek
Corbin Creek
Smokehouse Creek
Fuller Cr.
Mill Creek
Salmon Cr.
Squaw Valley Cr.
Cold Creek
Eel River
E2
D1
C1
LAKE PILLSBURY
D3
outlet
A1
D2
D1
dam
A2
B1
Eel River
Rice Creek
Rice Fork
LAKE PILLSBURY
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 5 10 Km.
0 2½ 5 Mi.
Scale

LAKE PILLSBURY

STORET NO. 0619

I. CONCLUSIONS

A. Trophic Condition*:

Survey data indicate Lake Pillsbury is eutrophic. It ranked thirteenth in overall trophic quality when the 24 California lakes and reservoirs sampled in 1975 were compared using a combination of six parameters**. Ten of the water bodies had less median total phosphorus, eight had less and one the same median orthophosphorus, nine had less and five the same median inorganic nitrogen, 15 had less mean chlorophyll a, and 21 had greater mean Secchi disc transparency. No significant decrease in dissolved oxygen with depth was apparent during Survey sampling; however, hypolimnetic depression has occurred during summer stratification (Bailey, 1977).

Survey limnologists observed an algal bloom in progress in the Rice Fork arm of the reservoir in March and emergent macrophytes along the north shoreline in June. Fish kills are reported to be a problem in the reservoir (Johns, 1975).

B. Rate-Limiting Nutrient:

The algal assay results indicate nitrogen limitation at the time the sample was collected (03/12/75).

The reservoir data indicate nitrogen limitation in March and November and phosphorus limitation at two of the three stations in June. However, the relatively low concentrations of chloro-

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* Trophic assessment is based on the levels of nutrients, dissolved oxygen, and chlorophyll a; phytoplankton kinds and numbers; and transparency (Allum et al., 1977).

** See Appendix A.

phyll a, the numbers of algae in the phytoplankton samples (page 6), and the lack of transparency (the mean Secchi disc depth was less than one meter) indicate primary productivity may be light-limited at times rather than nutrient-limited.

C. Nutrient Controllability:

1. Point sources--No known point sources impacted Lake Pillsbury during the sampling year.

The estimated phosphorus contribution of septic tank systems serving near-shore dwellings, camps, and parks amounted to less than 0.1% of the total load.

2. Non-point sources--The estimated phosphorus inputs of the gaged tributaries accounted for 82.7% of the total load reaching the reservoir during the sampling year. The ungaged drainage area was estimated to have contributed 16.8% of the total.

There was a loss of both phosphorus and nitrogen from the reservoir during the sampling year. The most probable reason for these losses was the lack of frequent sampling at the Eel River outlet (station A-1) during the period of the year when high flows occurred. This could result in an overestimation of nutrients leaving Lake Pillsbury via the Eel River, particularly since water is withdrawn from near the bottom of the reservoir (Puckett, 1969) where solubilization of previously sedimented nutrients is likely to occur.

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 8.10 kilometers^2.
2. Mean depth: 14.3 meters.
3. Maximum depth: 42.1 meters.
4. Volume: 115.830 x 10^6 m^3.
5. Mean hydraulic retention time: 87 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Eel River	362.6	7.530
Rice Fork	224.6	4.720
Squaw Valley Creek	9.1	0.215
Smokehouse Creek	32.9	0.775
Salmon Creek	32.6	0.771
Minor tributaries & immediate drainage -	78.6	2.056
Totals	740.4	16.067

2. Outlet -

Eel River	748.5**	15.410**

C. Precipitation***:

1. Year of sampling: 105.2 centimeters.
2. Mean annual: 97.6 centimeters.

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† Table of metric conversions--Appendix B.
†† Dendy, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of reservoir; lesser outflow due to evaporation.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Lake Pillsbury was sampled three times in 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at three stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the March visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 26.5 meters at station 1, 10.1 meters at station 2, and 15.8 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE PILLSBURY
STORET CODE 0619

PARAMETER	1ST SAMPLING (3/12/75) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (6/26/75) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (11/11/75) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	5.3 - 7.5	6.7	7.0	9.3 - 19.4	16.1	17.9	10.8 - 11.6	11.2	11.3
DISS OXY (MG/L)	10.6 - 11.0	10.9	11.0	6.8 - 10.0	8.6	9.0	8.2 - 10.4	8.7	8.4
CNDCTVY (MCHOMO)	60. - 82.	68.	67.	100. - 142.	127.	135.	71. - 110.	84.	85.
PH (STAND UNITS)	7.7 - 7.9	7.8	7.9	7.1 - 9.4	8.7	9.1	7.6 - 7.8	7.7	7.7
TOT ALK (MG/L)	38. - 54.	45.	45.	56. - 144.	71.	62.	71. - 91.	84.	88.
TOT P (MG/L)	0.063 - 0.214	0.113	0.099	0.013 - 0.034	0.020	0.019	0.016 - 0.024	0.019	0.019
ORTHO P (MG/L)	0.014 - 0.020	0.017	0.016	0.002 - 0.020	0.007	0.005	0.003 - 0.008	0.005	0.005
NO2+NO3 (MG/L)	0.020 - 0.050	0.034	0.035	0.020 - 0.430	0.065	0.020	0.020 - 0.020	0.020	0.020
AMMONIA (MG/L)	0.020 - 0.040	0.027	0.030	0.020 - 0.050	0.037	0.040	0.020 - 0.020	0.020	0.020
KJEL N (MG/L)	0.200 - 0.400	0.212	0.200	0.200 - 0.500	0.367	0.350	0.200 - 0.200	0.200	0.200
INORG N (MG/L)	0.047 - 0.080	0.061	0.060	0.040 - 0.450	0.102	0.060	0.040 - 0.040	0.040	0.040
TOTAL N (MG/L)	0.220 - 0.450	0.246	0.235	0.220 - 0.730	0.432	0.420	0.220 - 0.220	0.220	0.220
CHLRPYL A (UG/L)	0.6 - 0.8	0.7	0.7	13.0 - 18.0	15.9	16.6	1.3 - 3.7	2.6	2.8
SECCHI (METERS)	0.2 - 0.3	0.2	0.2	1.2 - 1.8	1.5	1.4	****** - **********		

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
03/12/75	1. Synedra sp.	10
	2. Euglena sp.	10
	Total	20
06/26/75	1. Anabaena sp.	1,861
	2. Cryptomonas sp.	64
	3. Trachelomonas sp.	64
	Total	1,989
11/11/75	1. Melosira sp.	331
	2. Cryptomonas sp.	37
	3. Dactylococcopsis sp.	37
	4. Chroomonas (?) sp.	36
	Total	441

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
03/12/75	1	0.6
	2	0.7
	3	0.8
06/26/75	1	13.0
	2	16.6
	3	18.0
11/11/75	1	2.8
	2	1.3
	3	3.7

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.015	0.040	0.6
0.050 P	0.065	0.040	1.5
0.050 P + 1.0 N	0.065	1.040	31.7
1.0 N	0.015	1.040	2.4

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Lake Pillsbury was low at the time the sample was collected (03/12/75). The lack of significant increase in yield with the addition of orthophosphorus, and the significant increase in yield when nitrogen alone was added, indicate nitrogen limitation.

The reservoir data indicate nitrogen limitation at all three stations in March and November (the mean inorganic nitrogen/orthophosphorus ratios were 4/1 and 8/1, respectively). In June, nitrogen limitation is indicated at station 1 (N/P = 7/1) but phosphorus limitation is indicated at stations 2 and 3 (N/P = 21/1 and 19/1, respectively).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the California National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February, March, and April when two samples were collected. Sampling was begun in November, 1974, and was completed in November, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the California District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient loads, in $kg/km^2/year$, at stations B-1, C-1, D-1, and E-1 and multiplying the means by the ZZ area in km^2.

No known wastewater treatment plant impacted Lake Pillsbury during the sampling year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Eel River	13,110	50.4
Rice Fork	4,550	17.5
Squaw Valley Creek	1,085	4.2
Smokehouse Creek	1,735	6.7
Salmon Creek	1,005	3.9
b. Minor tributaries & immediate drainage (non-point load) -	4,380	16.8
c. Known municipal STP's - None	-	-
d. Septic tanks* -	10	< 0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	140	0.5
Total	26,015	100.0

2. Outputs -

Reservoir outlet - Eel River 30,910

3. Net annual P loss - 4,895 kg.

* Estimate based on 17 dwellings, 3 campgrounds, and 1 picnic area; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Eel River	232,165	51.0
Rice Fork	78,420	17.2
Squaw Valley Creek	16,095	3.5
Smokehouse Creek	17,380	3.8
Salmon Creek	31,475	6.9
b. Minor tributaries & immediate drainage (non-point load) -	70,975	15.6
c. Known municipal STP's - None	-	-
d. Septic tanks* -	425	0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	8,745	1.9
Total	455,680	100.0

2. Outputs -

Reservoir outlet - Eel River 599,395

3. Net annual N loss - 143,715 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Eel River	36	640
Rice Fork	20	349
Squaw Valley Creek	119	1,769
Smokehouse Creek	53	528
Salmon Creek	31	966

* Estimate based on 17 dwellings, 3 campgrounds, and 1 picnit area; see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	3.21	loss*	56.36	loss*

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Lake Pillsbury:

"Dangerous" (eutrophic loading)	1.48
"Permissible" (oligotrophic loading)	0.74

* See page 2.

V. LITERATURE REVIEWED

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APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
0601	AMADOR RESERVOIR	0.040	0.390	408.667	22.383	14.600	0.020
0602	BOCA LAKE	0.012	0.040	372.833	1.700	6.800	0.003
0603	LAKE BRITTON	0.067	0.115	448.500	4.811	11.200	0.047
0604	CASITAS RESERVOIR	0.029	0.050	400.250	3.192	14.000	0.014
0605	CROWLEY LAKE	0.046	0.045	374.750	5.800	12.200	0.034
0606	DON PEDRO RESERVOIR	0.013	0.060	381.733	3.564	11.400	0.004
0607	LAKE ELSINORE	0.469	0.120	489.214	70.572	8.000	0.092
0608	FALLEN LEAF RESERVOIR	0.007	0.040	24.357	0.786	8.800	0.005
0609	LAKE HENNESSEY	0.027	0.060	416.000	4.525	15.000	0.012
0610	LAKE HENSHAW	0.138	0.070	461.000	26.783	9.800	0.073
0611	IRON GATE RESERVOIR	0.184	0.690	440.333	6.217	13.800	0.124
0614	LOPEZ LAKE	0.371	0.090	372.000	8.658	15.000	0.343
0615	LAKE MARY	0.010	0.040	296.000	2.550	10.600	0.002
0616	LAKE MENDOCINO	0.020	0.050	436.500	3.100	9.400	0.008
0617	NICASIO RESERVOIR	0.055	0.345	482.778	6.633	9.800	0.013
0618	LOWER OTAY RESERVOIR	0.058	0.180	447.250	15.933	15.000	0.013
0619	LAKE PILLSBURY	0.022	0.060	466.667	6.389	8.200	0.008
0620	SANTA MARGARITA LAKE	0.037	0.070	400.000	9.122	14.800	0.014
0621	SHASTA LAKE	0.021	0.060	381.542	4.087	9.000	0.015
0622	SHAVER	0.014	0.060	346.400	1.700	7.400	0.004
0623	SILVER LAKE	0.012	0.055	356.000	1.800	7.000	0.003
0624	TULLOCK RESERVOIR	0.025	0.060	433.000	13.878	7.400	0.009
0625	UPPER TWIN LAKES	0.015	0.040	300.200	3.340	7.400	0.004
0626	LOWER TWIN LAKES	0.014	0.040	248.000	2.900	11.400	0.003

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NU
0601	AMADOR RESERVOIR	35 (8)	4 (1)	43 (10)	9 (2)	17 (4)	26 (6)	134
0602	BOCA LAKE	89 (20)	98 (22)	70 (16)	91 (21)	100 (23)	91 (20)	539
0603	LAKE BRITTON	17 (4)	22 (5)	17 (4)	48 (11)	43 (10)	17 (4)	164
0604	CASITAS RESERVOIR	43 (10)	74 (17)	48 (11)	70 (16)	22 (5)	37 (8)	294
0605	CROWLEY LAKE	30 (7)	78 (18)	65 (15)	43 (10)	30 (7)	22 (5)	268
0606	DON PEDRO RESERVOIR	83 (19)	54 (11)	57 (13)	61 (14)	37 (8)	78 (17)	370
0607	LAKE ELSINORE	0 (0)	17 (4)	0 (0)	0 (0)	78 (18)	9 (2)	104
0608	FALLEN LEAF RESERVOIR	100 (23)	87 (19)	100 (23)	100 (23)	70 (16)	70 (16)	527
0609	LAKE HENNESSEY	48 (11)	54 (11)	39 (9)	52 (12)	4 (0)	52 (12)	249
0610	LAKE HENSHAW	13 (3)	33 (7)	13 (3)	4 (1)	54 (12)	13 (3)	130
0611	IRON GATE RESERVOIR	9 (2)	0 (0)	26 (6)	39 (9)	26 (6)	4 (1)	104
0614	LOPEZ LAKE	4 (1)	26 (6)	74 (17)	26 (6)	4 (0)	0 (0)	134
0615	LAKE MARY	96 (22)	87 (19)	91 (21)	83 (19)	48 (11)	100 (23)	505
0616	LAKE MENDOCINO	65 (15)	70 (16)	30 (7)	74 (17)	61 (14)	63 (14)	363
0617	NICASIO RESERVOIR	26 (6)	9 (2)	4 (1)	30 (7)	54 (12)	46 (10)	169
0618	LOWER OTAY RESERVOIR	22 (5)	13 (3)	22 (5)	13 (3)	4 (0)	46 (10)	120
0619	LAKE PILLSBURY	57 (13)	41 (9)	9 (2)	35 (8)	74 (17)	63 (14)	279
0620	SANTA MARGARITA LAKE	39 (9)	33 (7)	52 (12)	22 (5)	13 (3)	37 (8)	196
0621	SHASTA LAKE	61 (14)	54 (11)	61 (14)	57 (13)	65 (15)	30 (7)	328
0622	SHAVER	78 (18)	41 (9)	83 (19)	96 (22)	87 (19)	78 (17)	463
0623	SILVER LAKE	89 (20)	65 (15)	78 (18)	87 (20)	96 (22)	91 (20)	506
0624	TULLOCK RESERVOIR	52 (12)	54 (11)	35 (8)	17 (4)	87 (19)	57 (13)	302
0625	UPPER TWIN LAKES	70 (16)	98 (22)	87 (20)	65 (15)	87 (19)	78 (17)	485
0626	LOWER TWIN LAKES	74 (17)	87 (19)	96 (22)	78 (18)	37 (8)	91 (20)	463

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	0602	BOCA LAKE	539
2	0608	FALLEN LEAF RESERVOIR	527
3	0623	SILVER LAKE	506
4	0615	LAKE MARY	505
5	0625	UPPER TWIN LAKES	485
6	0626	LOWER TWIN LAKES	463
7	0622	SHAVER	463
8	0606	DON PEDRO RESERVOIR	370
9	0616	LAKE MENDOCINO	363
10	0621	SHASTA LAKE	328
11	0624	TULLOCK RESERVOIR	302
12	0604	CASITAS RESERVOIR	294
13	0619	LAKE PILLSBURY	279
14	0605	CROWLEY LAKE	268
15	0609	LAKE HENNESSEY	249
16	0620	SANTA MARGARITA LAKE	196
17	0617	NICASIO RESERVOIR	169
18	0603	LAKE BRITTON	164
19	0614	LOPEZ LAKE	134
20	0601	AMADOR RESERVOIR	134
21	0610	LAKE MENSHAW	130
22	0618	LOWER OTAY RESERVOIR	120
23	0607	LAKE ELSINORE	104
24	0611	IRON GATE RESERVOIR	104

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR CALIFORNIA 12/02/76

LAKE CODE 0619 LAKE PILLSBURRY

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 748.5

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
0619A1	748.5	35.68	40.21	25.85	19.60	9.23	5.52	5.55	5.64	6.06	6.14	6.48	20.61	15.41
0619A2	362.6	19.26	19.82	14.44	12.18	6.23	2.32	0.59	0.28	0.23	0.82	3.96	11.04	7.53
0619B1	224.6	11.61	13.03	9.06	6.80	2.83	1.08	0.34	0.17	0.14	0.51	2.52	9.06	4.72
0619C1	9.1	0.623	0.623	0.396	0.261	0.059	0.020	0.0	0.0	0.0	0.0	0.110	0.510	0.215
0619D1	32.9	2.010	2.464	1.331	0.963	0.311	0.125	0.048	0.0	0.0	0.068	0.425	1.671	0.775
0619E2	32.6	1.982	2.435	1.331	0.963	0.311	0.125	0.048	0.0	0.0	0.071	0.425	1.671	0.771
0619ZZ	86.8	6.230	6.230	3.681	2.379	0.368	0.099	0.042	0.0	0.0	0.198	0.878	4.814	2.056

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 748.5
SUM OF SUB-DRAINAGE AREAS = 748.5

TOTAL FLOW IN = 194.62
TOTAL FLOW OUT = 186.58

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
0619A1	11	74	8.495	17	8.693				
	12	74	7.023	14	7.957				
	1	75	5.550	19	7.334				
	2	75	51.253	1	5.748	22	46.156		
	3	75	85.234	8	131.956	18	206.996		
	4	75	21.662	5	19.340	20	19.765		
	5	75	17.188	3	26.023				
	7	75	3.794	28	3.568				
	8	75	3.426	31	3.426				
	9	75	8.410	21	8.835				
	10	75	8.212	11	8.212				
0619A2	11	74	0.368	16	0.311				
	12	74	3.115	15	0.906				
	1	75	5.097	19	3.115				
	2	75	36.812	2	26.618	23	13.592		
	3	75	42.475	9	53.802	19	76.455		
	4	75	14.158	6	17.556	20	9.628		
	5	75	9.061	4	12.743	31	4.248		
	6	75	2.492	7	3.115				
	7	75	0.481	29	0.311				
	8	75	0.0	31	0.0				
	9	75	0.0	21	0.0				
	10	75	0.0	12	0.0				

TRIBUTARY FLOW INFORMATION FOR CALIFORNIA 12/02/76

LAKE CODE 0619 LAKE PILLSBURRY

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
061981	11	74	0.227	16	0.198				
	12	74	1.954	15	0.566				
	1	75	3.115	19	1.897				
	2	75	22.087	2	16.424	23	8.495		
	3	75	25.768	9	33.980				
	4	75	8.778	6	10.760	19	6.230		
	5	75	5.663	3	7.929				
	6	75	1.529	7	2.010				
	7	75	0.311	29	0.198				
	8	75	0.0	31	0.0				
	9	75	0.0	7	0.0				
0619C1	11	74	0.008	17	0.008				
	12	74	0.085	14	0.023				
	1	75	0.113	19	0.085				
	2	75	0.878	1	0.878	22	0.396		
	3	75	1.019	8	1.897	18	2.435		
	4	75	0.340	5	0.453	20	0.227		
	5	75	0.227	3	0.311				
	6	75	0.057	7	0.079				
	7	75	0.0	28	0.0				
	8	75	0.0	31	0.0				
	9	75	0.0	20	0.0				
	10	75	0.0	12	0.0				
061901	11	74	0.034	17	0.0				
	12	74	0.283	14	0.085				
	1	75	0.453	19	0.283				
	2	75	3.115	1	3.115	22	1.388		
	3	75	3.681	8	6.796	18	8.778		
	4	75	1.303	5	1.642	20	0.850		
	5	75	0.821	3	1.161				
	6	75	0.227	7	0.283				
	7	75	0.045	28	0.0				
	8	75	0.0	31	0.0				
	9	75	0.0	20	0.0				
	10	75	0.0	11	0.0				
0619E2	11	74	0.034	17	0.0				
	12	74	0.283	14	0.085				
	1	75	0.453	19	0.283				
	2	75	3.115	1	3.115	22	1.388		
	3	75	3.681	8	6.796	18	8.778		
	4	75	1.303	5	1.642	20	0.850		
	5	75	0.821	3	1.133				
	6	75	0.227	7	0.283				
	7	75	0.045	28	0.0				
	8	75	0.0	31	0.0				
	9	75	0.0	20	0.0				
	10	75	0.0	11	0.0				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/09/24

061401
39 24 26.0 122 57 20.0 3
LAKE PILLSBURY
06033 CALIFORNIA
140291

11EPALES 2111202
0085 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/12	10 25	0000	7.5	10.6	10	79	7.90	51	0.030	0.400	0.050	0.017
	10 25	0005	7.5	10.6		79	7.90	52	0.020K	0.200K	0.040	0.016
	10 25	0015	7.0	11.0		82	7.85	54	0.020	0.200K	0.040	0.017
	10 25	0025	5.8	11.0		67	7.70	46	0.040	0.200K	0.040	0.016
	10 25	0040	5.3	11.0		62	7.70	40	0.030	0.200K	0.040	0.018
	10 25	0060	5.6	11.0		60	7.90	40	0.030	0.200K	0.040	0.020
	10 25	0081	5.7	11.0		62	7.75	38	0.030	0.200K	0.040	0.020
75/06/26	10 00	0000	17.9	10.0	72	140	9.10	70	0.040	0.600	0.020	0.005
	10 00	0005	17.9	9.0		135	9.15	70	0.040	0.600	0.020K	0.005
	10 00	0015	17.7	9.0		137	9.15	60	0.040	0.400	0.020	0.005
	10 00	0025	17.7	9.0		135	9.10	62	0.040	0.400	0.020K	0.004
	10 00	0035	12.3	7.2		115	8.10	60	0.020	0.200	0.020K	0.009
	10 00	0055	10.4	7.4		100	7.75	56	0.040	0.200	0.020	0.014
	10 00	0087	9.3	7.6		102	7.10	56	0.040	0.200K	0.030	0.014
75/11/11	10 40	0000	11.6	8.6		85	7.70	87	0.020K	0.200K	0.020K	0.004
	10 40	0005	11.6	8.8		91	7.70	88	0.020K	0.200K	0.020K	0.004
	10 40	0015	11.6	10.4		86	7.70	89	0.020K	0.200K	0.020K	0.004
	10 40	0035	11.4	8.4		78	7.70	73	0.020K	0.200K	0.020K	0.005
	10 40	0056	10.9	8.2		110	7.60	91	0.020K	0.200K	0.020K	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/03/12	10 25	0000	0.070	0.6	
	10 25	0005	0.065		
	10 25	0015	0.070		
	10 25	0025	0.093		
	10 25	0040	0.136		
	10 25	0060	0.214		
	10 25	0081	0.211		
75/06/26	10 00	0000	0.019	13.0	
	10 00	0005	0.016		
	10 00	0015	0.019		
	10 00	0025	0.015		
	10 00	0035	0.016		
	10 00	0055	0.034		
	10 00	0087	0.026		
75/11/11	10 40	0000	0.016	2.8	
	10 40	0005	0.016		
	10 40	0015	0.017		
	10 40	0035	0.020		
	10 40	0056	0.021		

STORET RETRIEVAL DATE 76/09/24

061902
39 25 52.0 122 58 24.0 3
LAKE PILLSBURY
06033 CALIFORNIA

140291

11EPALES 2111202
0028 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/12	11 20	0000	7.2	10.6	8	65	7.90	38	0.030	0.200K	0.030	0.014
	11 20	0005	7.0	10.8		64	7.90	40	0.020	0.200	0.030	0.015
	11 20	0015	6.9	10.6		65	7.90	41	0.040	0.200K	0.040	0.019
	11 20	0024	7.0	10.8		66	7.80	42	0.030	0.200K	0.030	0.015
75/06/26	10 45	0000	18.9	9.4	54	135	9.15	62	0.040	0.600	0.020	0.002
	10 45	0005	18.7	9.4		135	9.30	62	0.040	0.500	0.020K	0.003
	10 45	0015	18.4	9.0		134	9.20	61	0.050	0.400	0.020K	0.003
	10 45	0022	18.1	9.0		132	9.20	63	0.040	0.300	0.020K	0.003
	10 45	0033	13.5	6.8		116	8.10	59	0.040	0.200	0.020	0.004
75/11/11	10 00	0000	11.1	8.8		76	7.75	71	0.020K	0.200K	0.020K	0.003
	10 00	0005	10.8	9.0		75	7.75	71	0.020K	0.200K	0.020K	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/03/12	11 20	0000	0.097	0.7	
	11 20	0005	0.123		
	11 20	0015	0.092		
	11 20	0024	0.102		
75/06/26	10 45	0000	0.015	16.6	
	10 45	0005	0.023		
	10 45	0015	0.018		
	10 45	0022	0.018		
	10 45	0033	0.013		
75/11/11	10 00	0000	0.024	1.3	
	10 00	0005	0.019		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

061903
39 24 50.0 122 56 08.0 3
LAKE PILLSBURY
06033 CALIFORNIA

140291

11EPALES 2111202
0056 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/12	12 00	0000	7.5	11.0	8	70	7.80	47	0.020	0.200K	0.020	0.016
	12 00	0005	7.3	11.0		69	7.80	47	0.020	0.200K	0.020	0.016
	12 00	0015	7.3	11.0		69	7.90	47	0.020	0.200K	0.020	0.015
	12 00	0030	6.7	11.0		68	7.90	49	0.020K	0.200K	0.030	0.017
	12 00	0052	5.6	11.0		63	7.90	44	0.030	0.200K	0.030	0.018
75/06/26	11 55	0000	19.4	9.4	48	142	9.40	144	0.030	0.300	0.410	0.015
	11 55	0005	19.3	9.6		139	9.40	141	0.020K	0.300	0.430	0.020
	11 55	0015	18.6	9.6		138	9.40	65	0.040	0.400	0.020K	0.003
	11 55	0020	18.3	8.6		139	9.15	64	0.040	0.600	0.020K	0.003
	11 55	0035	12.8	7.6		106	7.85	60	0.030	0.200	0.020K	0.006
	11 55	0051	10.4	7.8		105	7.80	60	0.030	0.200	0.020K	0.010
75/11/11	09 15	0000	11.3	8.4		93	7.70	88	0.020K	0.200K	0.020K	0.006
	09 15	0005	11.3	8.4		71	7.70	88	0.020K	0.200K	0.020K	0.008
	09 15	0015	11.3	8.4		88	7.70	87	0.020K	0.200K	0.020K	0.005
	09 15	0031	10.8	8.4		75	7.70	90	0.020K	0.200K	0.020K	0.004

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/03/12	12 00	0000	0.063	0.8	
	12 00	0005	0.090		
	12 00	0015	0.112		
	12 00	0030	0.115		
	12 00	0052	0.151		
75/06/26	11 55	0000	0.021	18.0	
	11 55	0005	0.028		
	11 55	0015	0.019		
	11 55	0020	0.020		
	11 55	0035	0.017		
	11 55	0051	0.022		
75/11/11	09 15	0000	0.020	3.7	
	09 15	0005	0.024		
	09 15	0015	0.019		
	09 15	0031	0.018		

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/09/24

061941
39 24 25.0 122 57 45.0 4
EEL RIVER
06 7.5 LK PILLSBURY
0/LAKE PILLSBURY 140291
BNK END UNPVD RD .2 MI BELO SCOTT DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/17	10 55		0.016	0.700	0.045	0.007	0.020
74/12/14	12 00		0.040	0.700	0.103	0.010	0.060
75/01/19	13 30		0.056	1.500	0.115	0.030	0.030
75/02/01	14 15		0.072	1.750	0.168	0.017	0.100
75/02/22	10 35		0.032	0.700	0.043	0.024	0.100
75/03/04	11 00		0.016	0.300	0.008K	0.024	0.040
75/03/18	11 00		0.022	1.650		0.031	0.155
75/04/05	14 30		0.015	2.400	0.035	0.020	0.080
75/04/20	11 00		0.010	0.700	0.020	0.020	0.060
75/05/03	11 00		0.015	1.600	0.020	0.020	0.070
75/07/28	11 00		0.070	0.150	0.015	0.010	0.050
75/08/31	11 00		0.130	0.400	0.005	0.005K	0.040
75/09/21	12 15		0.010		0.025	0.005	
75/10/11	11 00		0.015	2.600	0.040	0.005K	0.030
75/11/02	12 50		0.005	0.400	0.010	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

0619A2
39 23 45.0 122 52 52.0 4
EEL RIVER
06 7.5 LK PILLSBURY
T/LAKE PILLSBURY 140291
BNK 100 FT W OF JEEP TRAIL
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/16	15	45	0.016	2.100	0.065	0.020	0.120
75/01/19	13	30	0.008	1.000	0.030	0.020	0.020
75/06/07	12	30	0.010	0.500	0.015	0.020	0.070
75/07/29	14	30	0.005	0.050K	0.005K	0.025	0.040
75/08/31	14	20	0.015	0.500	0.015	0.010	0.030
75/09/21	15	30	0.015	0.100K	0.005K	0.025	0.025

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

061481
39 22 40.0 122 55 05.0 4
RICE FORK
06 7.5 LK PILLSBURY
T/LAKE PILLSBURY 140291
JEEP TRL XING 2.8 MI SE OF SCOTT DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/16	14	05	0.008	1.000	0.075	0.020	0.020
74/12/15	11	30	0.192	0.600	0.010	0.010	0.010
75/02/23	11	45	0.015	0.700	0.016	0.016	0.030
75/04/19	14	00	0.005	0.300	0.005	0.020	0.020
75/05/03	11	00	0.015	0.050K	0.010	0.010	0.030
75/06/07	13	00	0.065	0.300	0.010	0.010	0.040
75/07/29	11	00	0.015	0.100	0.010	0.010	0.015
75/08/31	12	00	0.010	0.900	0.015	0.015	0.040
75/09/07	12	00	0.030	0.500	0.015	0.015	0.030

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

0619C1
39 26 15.0 122 55 45.0 4
SQUAW VALLEY CREEK
06 7.5 LK PILLSBURY
T/LAKE PILLSBURY 140291
UNPVD RD BRDG .5 M E OF SUNSET PT CMPGRD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/17	11	25	0.024	0.400	0.020	0.025	0.025
74/12/14	13	30	0.064	1.300	0.025	0.025	0.030
75/01/19	14	40	0.144	1.400	0.015	0.020	0.020
75/02/01	14	45	0.032	0.900	0.024	0.015	0.030
75/02/22	14	00	0.032	0.400	0.016	0.016	0.020
75/03/08	14	00	0.024	0.600	0.008K	0.024	0.130
75/03/18	14	00	0.010	1.400	0.022	0.024	0.090
75/04/05	15	00	0.005	1.380	0.020	0.035	0.110
75/04/20	13	30	0.005	0.550	0.015	0.020	0.020
75/05/03	14	00	0.010	0.150	0.010	0.020	0.050
75/06/07	15	30	0.010	0.050K	0.030	0.043	0.045

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

061901
39 27 35.0 122 57 10.0 4
SMOKEHOUSE CREEK
06 7.5 LK PILLSBURY
T/LAKE PILLSBURY 140291
BNK 1.3 MI NW OF HULL MT RD JCT
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/01/19	14	10	0.008	0.200	0.005K	0.010	0.019
75/02/01	15	00	0.008	0.500	0.008K	0.010	0.010
75/02/22	13	00	0.016	0.400	0.012	0.016	0.020
75/03/08	13	00	0.008	0.400	0.008K	0.016	0.130
75/03/18	13	00	0.007	2.300	0.070	0.022	0.100
75/04/05	14	00	0.010	0.500	0.015	0.040	0.160
75/04/20	13	00	0.005	0.500	0.025	0.015	0.030
75/05/03	13	00	0.010	0.450	0.015	0.015	0.040
75/06/07	14	30	0.005	0.550	0.015	0.015	0.040

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/09/24

0619E2
39 27 13.0 122 57 55.0 4
SALMON CREEK
06 7.5 LK PILLSBURY
T/LAKE PILLSBURY 140291
END OF RD 2.2 MI N OF SODA CREEK STATION
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/12/14	19 00		0.072	0.400	0.010	0.015	0.015
75/01/19	14 00		0.016	1.200	0.010	0.015	0.015
75/02/01	15 15		0.008	0.800	0.008K	0.010	0.010
75/02/22	11 30		0.008	0.700	0.008K	0.016	0.020
75/03/08	12 00		0.008	0.500	0.008K	0.016	0.090
75/03/18	12 00		0.006	1.650		0.027	0.110
75/04/05	14 45		0.005	1.650	0.030	0.015	0.020
75/04/20	11 50		0.005	1.800	0.025	0.015	0.020
75/05/03	12 00		0.010	1.000	0.015	0.015	0.040
75/06/07	13 30		0.010	0.600	0.015	0.015	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED